"Observations on the Sex of Mice.—Preliminary Paper." By S. MONCKTON COPEMAN, M.A., M.D., F.R.S., and F. G. PARSONS, F.R.C.S. Received December 1, 1903,—Read January 28, 1904.

In this communication we record the results obtained, during a period of fifteen months, from the breeding of fancy mice. The experiments were commenced with the object of determining the extent, if any, to which the relative proportion of the sexes is capable of being influenced by varying conditions of age, nutrition, inter-breeding, etc. The work is still in progress, but in the hope of obtaining help and criticism from other observers, we think it desirable to put on record the experimental work that has already been carried out.

Our paper consists of two parts: (*a*) a list of the various crossings and their results, a record which we believe to be perfectly trustworthy; and (*b*) a series of conclusions at which we have arrived after careful study of the figures. As these conclusions form the most generally interesting portion of the paper, we have decided to place them first, especially as the mere statistics are only likely to be of use in the criticism of our deductions or in furnishing material by the aid of which others, not at first apparent, may perhaps be formulated.

In using these tables an explanation of our symbols may be necessary; it should, for instance, be noticed that all the bucks are indicated by small Greek letters—the does by Roman capitals. When a numeral follows the letter representing a particular doe, it shows that the bearer is the daughter of the doe whose indication is the letter alone. Thus, B^2 represents the second daughter which we kept of B, while $B^{2 \cdot 3}$ refers to the third daughter kept of B^2, and, consequently, the granddaughter of B. This method, of course, gives no clue to the male ancestry of a mouse, but this can always be ascertained by referring to the record of the particular animal. If we translate one line taken at random from the doe's record it will, perhaps, make our system clear:

C^1 (to ϵ). Sept. 22/02. 2 ♂, 4 ♀ (♀ $3\frac{1}{2}$ m., ♂ at least 4 m.)

This means that on September 22, 1902, C^1 (a daughter of C) bore two males and four females to the buck ϵ, and that at the time of conception (some 20 days before) the mother was $3\frac{1}{2}$ months old, while the father was at least 4 months. On looking at the top of the paragraph devoted to C^1 in the doe's record, her percentage will be seen, while all that is known of the ancestry of ϵ will be found at the top of the paragraph devoted to him in the buck's record.

Part I.—Generalisations.

The first question as to which we are desirous of obtaining information concerns the possibility of the male or female parent, in any particular instance, exerting a marked influence in the direction of a preponderance of male or female offspring. In seeking an answer to this question it is necessary to state that out of the total number of 493 young produced in the course of our experiments, 258, or 52·3 per cent., were of the male sex, and 235, or 47·7 per cent., of the female sex.

Taking the buck's descendants first, we have the following records :—

	♂.	♀.
α	71 (48 per cent.)	77 (52 per cent.)
β	18 (66·5 „)	9 (33·5 „)
γ	28 (46·5 „)	32 (53·5 „)
δ	52 (57 „)	39 (43 „)
ϵ	25 (43 „)	33 (57 „)
ζ	6	2
η	33 (66 „)	17 (34 „)
θ	7	6
ι	18 (51 „)	17 (49 „)
κ	0	3
	258	235

The cases of ζ, θ and κ may be left out of consideration, as the numbers of their offspring are so few. Of the rest, α and ι closely approach the normal, but β, δ and η have male offspring in excess, in connection with which fact it must be remembered that δ was the son of β. On turning to the record of β, we find that in the case of all five does with which he was mated, the male offspring was in excess, and in the case of δ also when put to five different does in succession, more males were produced than females in every instance. η was put to seven does—five times males were in excess, once the sexes were equal, while only once (with $C^{1\cdot2\cdot2\cdot1}$) were there more females than males produced. γ and ϵ on the other hand had female offspring in excess of male to a rather marked degree, and in each case the record is taken from more than fifty young. With γ the females were in excess of the males in four litters out of nine, while in two others the sexes were equal, so that in only three out of nine litters were there more males than females. In the case of ϵ the females were in excess in five litters out of nine, while in one other the sexes were equal. In this case too there were more males than

females in only three litters out of nine. When it is remembered that all these bucks were put to at least five different does selected at random, it certainly does appear that some bucks have a tendency to beget more male, and others more female offspring. This, we believe, is the experience of many breeders of animals. It may be objected that these bucks were not placed with exactly the same series of does in each instance, and we regret that this is so, but by looking through the records of δ (a male producer) and ϵ (a female producer) it will be noted that they both had young by the three does B^2, C^1 and D^1, with the following results :—

	δ.		ε.	
	♂	♀	♂	♀
B^2	2	1	4	2
C^1	3	2	1	6
D^1	9	6	3	4
	14	9	8	12

so that their tendency to produce an excess of male or female offspring would appear to have had no relation to the particular does with which they were mated.

With regard to β (a male producer) and γ (a female producer), both had young by the four does A B D and F with the following results :—

	β.		γ.		
	♂	♀	♂	♀	
A	4	3	4	0	
B	1	4	7	9	(in 3 litters)
D	3	2	8	8	(in 2 ,,)
F	4	3	4	3	
	12	12	23	20	

This is not nearly so satisfactory a result for our contention, as with the same does γ (the female producer) actually produced a larger proportion of males than did β (the male producer).

We shall, therefore, content ourselves by saying that δ and η are instances of bucks which tend to produce an excess of male, and ϵ of one producing excess of female offspring.

On looking through the record of the does the point that is most striking is the behaviour of C^1 and her descendants :—

		♂.	♀.
C^{1}	produced	9	17
$C^{1\cdot 2}$	,,	3	11
$C^{1\cdot 2\cdot 1}$	,,	2	3
$C^{1\cdot 2\cdot 2}$	,,	2	5
$C^{1\cdot 2\cdot 2\cdot 1}$	,,	5	10
		21	46
		(31 per cent.)	(69 per cent.)

On the other hand $C^{1\cdot 3}$ had 17 male and 6 female young, but she was a daughter of ϵ not of α. There is, however, an influence at work in this family which may possibly account for the excess of females over males, and it is that the same buck α was largely responsible for the results, as each of the does was put to him; thus $C^{1\cdot 2\cdot 2\cdot 1\cdot}$ was his daughter on the male side, and his great, great granddaughter on the female. It has already been noted that α was a buck who produced practically the normal proportion of young, so that his influence alone is not likely to account for the excess of females. But the practice of inbreeding a buck with his daughter, granddaughter, &c., for several generations may perhaps account for an excess of female offspring; this theory being strengthened by the fact that $C^{1\cdot 2\cdot 2\cdot 1\cdot}$ was the only doe with which the male-producing buck η had more females than males in a litter. The clue is one which we are now following up and which we would suggest to other breeders as worthy of further investigation. On the whole, our statistics seem to point to the fact that certain bucks and does tend to produce a preponderance of one sex, but that the influence is greater in the male parent; also that a doe which is the result of prolonged inbreeding is more likely to produce female than male offspring.

The next point inquired into refers to the possibility of the number of young in a litter exerting any influence on the proportion of the sexes. If there is any basis of fact in the theory that the amount of nourishment an embryo receives affects the determination of its sex, we should expect that large litters would show a predominance of one sex and small litters a predominance of the other. Up to the present we have neglected the young which were eaten by their mothers before their sex had been determined, because we have no reason to believe that the mother preferred to eat male or female young, and, in taking large numbers, we have presumed that as many male as female young would be eaten in this way. We have, however, kept a record of the total number in each litter when first seen; often an hour or two, and never more than 12 hours after the birth. A doe hardly ever eats the whole of a young one at once, as she apparently prefers to first eat the viscera and brains of several, leaving their carcases for a future meal. So that, even after 12 hours from the birth, it is easy to see, by the

remains, how many young have been eaten. The record of these litters, with the proportions of the surviving young, are as follows:—

Number.	Doe.	Number in litter.	Surviving males.	Surviving females.	Eaten.
1......	A	4	4	—	
2......	,,	7	4	3	
3......	,,	4	4	—	
4......	B	7	4	3	
5......	,,	5	4	1	
6......	,,	5	3	2	
7......	,,	5	2	3	
8......	,,	6	2	4	
9......	C	5	2	2	1
10......	,,	3	3		
11......	D	4	1	3	
12......	,,	6	3	2	1
13......	,,	8	4	4	
14......	,,	8	4	4	
15......	,,	7	7		
16......	E	8	4	4	
17......	F	9	3	1	5
18......	,,	7	4	3	
19......	,,	7	4	3	
20......	,,	9	1	6	2
21......	B^1	7	2	3	2
22......	B^2	6	2	1	3
23......	,,	8	4	2	2
24......	,,	3	2	1	
25......	,,	10	4	4	2
26......	B^3	8	2	5	1
27......	,,	9	4	5	
28......	,,	7	2	3	2
29......	C^1	7	3	2	2
30......	,,	7	1	6	
31......	,,	9	2	7	
32......	,,	7	3	2	
33......	C^2	2	1	1	
34......	,,	9	5	1	3
35......	,,	6	2	4	
36......	,,	7	3	3	1
37......	,,	6	3	3	
38......	,,	3	—	3	
39......	D^1	7	2	5	
40......	,,	7	3	4	
41......	,,	8	5	3	
42......	,,	7	5	2	
43......	,,	8	4	4	
44......	D^2	5	1	4	
45......	,,	8	4	4	
46......	,,	11	4	3	4
47......	,,	9	3	3	3
48......	D^3	6	3	3	
49......	,,	5	1	4	
50......	,,	8	3	5	
51......	$B^{2\cdot1}$	8	2	3	3
52......	,,	4	1	2	1
53......	,,	9	6	3	
54......	,,	5	3	2	

Number.	Doe.	Number in litter.	Surviving males.	Surviving females.	Eaten.
55......	$B^{2\cdot1}$	6	4	2	
56......	$B^{2\cdot2}$	7	5	2	
57......	$B^{3\cdot1}$	5	4	1	
58......	$B^{3\cdot2}$	10	6	4	
59......	$C^{1\cdot2}$	7	1	5	1
60......	”	8	2	6	
61......	$C^{1\cdot3}$	8	5	3	
62......	”	8	6	2	
63......	”	7	6	1	
64......	$D^{1\cdot1}$	5	2	1	
65......	$D^{2\cdot3}$	5	5		
66......	$D^{3\cdot3}$	4	2	2	
67......	$C^{1\cdot2\cdot1}$	5	2	3	
68......	$C^{1\cdot2\cdot2}$	7	2	5	
69......	$C^{1\cdot2\cdot2\cdot1}$	10	2	6	2
70......	”	7	3	4	
71......	G	3	1	2	
72	”	7	5	2	
73......	H	8	6	2	
		487*	231	211	45

This table shows that 487 young were produced in 73 litters, thus giving an average of 6·7 for a litter. There are 45 litters of 7 or over, and 28 of under 7. These we may speak of as large and small litters respectively. If the number of young in the 45 large litters is added up it amounts to 356, and of these 164 (46 per cent.) were males; 155 (43·5 per cent.) females; while 37 (10·5 per cent.) were eaten and their sex undetermined. Similarly if the number of young in the 28 small litters is taken we get a total of 131; of these 67 (51 per cent.) were males; 56 (43·7 per cent.) females; while 8 (6 per cent.) were eaten. Tabulated these results are as follows:—

	♂ per cent.	♀ per cent.	Eaten per cent.
Large litters (over 6)	46	43·5	10·5
Small litters (6 or under) ...	51	43	6

This result suggests two conclusions—firstly, that in a large litter a greater percentage of young is eaten by the mother, which is, perhaps, what one would expect, and, secondly, that in small litters there is a slightly greater percentage of males than in large ones. Other things being equal, one might fairly suppose that, in a small litter, each individual embryo would be better nourished than in a large litter, and this

* The records of the six does with which the buck δ was placed in a large cage have not been added in, because we have no means of knowing how many were eaten.

supposition is strengthened by our experience that, in small litters, the young are individually of greater size than we have found to be the case in larger families. The difference between the percentages of the large and small litters is not great enough to enable any general conclusion to be drawn from it, but, so far as it goes, it suggests that ample nourishment is more likely to result in an excess of male rather than of female offspring.

The next point to be discussed is whether the age of either parent affects the proportion of sexes in the young. As an aid to the determination of this question the records of all the does of two months or under at the time of conception, may be compared with those of all the does of 6 months or over.

We have records of 21 litters produced by does up to 2 months of age. These give a total of 108 young, of which 55 (51 per cent.) are males, and 53 (49 per cent.) females. With does over 6 months old we have also records of 21 litters, with a total of 134 young; of these 74 (55 per cent.) are males and 60 (45 per cent.) females. These figures show that there is an increase in the proportion of males to females in the progeny of those does over 6 months of age. It will now be worth while noticing that the does at intermediate ages, that is, from $2\frac{1}{2}$—$5\frac{1}{2}$ months (inclusive), produced 27 litters, giving a total of 173 young, of which 85 (49 per cent.) were males, and 88 (51 per cent.) females.

Tabulated, we arrive at the following results:—

	♂ per cent.	♀ per cent.
Does up to and including 2 months	51	49
,, between $2\frac{1}{2}$ and $5\frac{1}{2}$ months............	49	51
,, of 6 months and over	55	45

This suggests that, in does over 6 months old, the proportion of males to females increases, but we are unable to deduce anything from this knowledge at present, for the reason that we do not know the duration of the breeding period of a doe, nor at what stage the young are likely to receive the greatest amount of nourishment. Moreover, the difference in the proportion of the sexes among the young is not a very great one, and, doubtless, there are many other influences at work, the effect of which it is difficult to eliminate. One of these is the tendency, of which proof has been adduced, that certain bucks produce a preponderance of male or female offspring, but this tendency, to a certain extent, has been neutralised by the fact that our statistics have been drawn from the pairing of ten bucks with twenty-eight does. It is unfortunate that the buck of which we possess most records should have been paired so extensively with does under 6 months of age, as had he been put with an equal number of old and young does, it would have been interesting to have determined

whether the percentages of male and female young would have varied. Some little information may, however, be obtained from the record of δ, who when he was mated with five does of an average age of 7 months, produced 65 per cent. of male offspring, while with six does averaging 2 months old the male offspring was only 53 per cent. Though the numbers here are small (eighty-three young in all), the record certainly supports the suggestion that an adult doe is more likely to bring forth an excess of male offspring than a very young one.

With regard to the effect of the age of the buck we are unfortunately unable to give any definite opinion, since the bucks from which we chiefly bred were apparently fully grown when purchased, though we had no means of actually determining their age. It will be seen, on looking at the record of α, that in his later offspring females predominated, but there three factors at least are concerned: (1) The advanced age of the buck; (2) the predisposition of C^1 and her descendants to produce females; and (3) the possibility that the excessive inbreeding to which these mice were subjected may have led to an increase of females.

The last factor we propose to consider at the present time is that of external temperature. The mice were kept in an unheated greenhouse in which the temperature usually ranged between 80° and 100° F. during the day-time in summer, while in winter it often descended several degrees below freezing point. It may be interesting to contrast the records of the young born in July, August and September with those born in December, January, February and March, and both of these with the total records for the whole 15 months over which our experiments extended. During the 3 hot months 136 young were born, of which 75 (55 per cent.) were males, and 61 (45 per cent.) females, while during the 4 cold months 127 young were born, of which 65 (51 per cent.) were males and 62 (49 per cent.) females.

	♂.	♀.
Three hot months...............	55 per cent.	45 per cent.
Four cold months	51 ,,	49 ,,
Total records for 15 months...	53·3 ,,	46·7 ,,

These results do not seem to indicate that temperature or time of year exerts any marked effect on the proportion of the sexes in the young.

In conclusion it must be confessed that we have learnt comparatively little from this 15 months' experimental work on mice, but we are hopeful that the labour has not been entirely expended in vain, and that at least certain clues have been obtained which may usefully be followed up, both by ourselves and other breeders. So far as our experiments have gone, the chief points of interest would seem to be :—

1. That the number of males born is slightly larger than that of females.

2. That certain males beget a markedly large proportion of male, and others of female offspring.

3. That there is some evidence that this tendency is hereditary.

4. That certain does tend to bear an excess of either male or female offspring, but the evidence of this is not so conclusive as in the case of the male.

5. That mice bear inbreeding between a male and his offspring for five generations without loss of fertility or apparent bodily degeneration—this inbreeding in our one series of experiments being attended with a large excess of female offspring.

6. That the average number of young in a litter, judged from seventy-three litters, is 6·7.

7. That in large litters more of the young are likely to be eaten by the mother than in small ones.

8. That in large litters the proportion of females is greater than in small ones.

9. That more males are produced by does over 6 months than is the case with does under that age.

10. That the temperature and time of year at which impregnation occurs seem to exert little or no influence on the proportion of male and female offspring.

Of course the larger the number of experiments the greater will be the likelihood of obtaining reliable statistics, so that it will be interesting to determine whether another year's breeding confirms or neutralises the results now recorded, but we think it desirable to publish our observations at this stage, for two reasons, firstly, to invite criticism on our methods and suggestions for future work, and, secondly, to indicate to other breeders clues which would appear worth while following up.

It should, perhaps, be mentioned that, in each instance, careful record has been kept of the *colour* of the individual mice mated together, and also of that of their progeny. These results we have handed over to Mr. Bateson, by whom they have been utilised in connection with his investigation of Mendel's theory of inheritance of parental characteristics.*

* 'Zool. Soc. Proc.,' 1903, vol. 2, p. 83.

Part II.—Records.

A. *Does' Records.*

1. Doe A (bought on April 18, 1902, under breeding age).

		♂.	♀.	♀.	♂.
To α	May 9/02	4	0	About 2 m.	At least 4 m.
„ β	June 22/02	4	3	„ 3 „	„ 5 „
„ γ	Oct. 2/02	4	0	„ 7 „	„ 4 „
		12	3		

2. Doe B (bought April 18, 1902, under breeding age).

		♂.	♀.	♀.	♂.
To α	May 11/02	4	3	About 2 m.	At least 4 m.
„ β	July 16/02	4	1	„ 3½ „	„ 4½ „
„ γ	Sept. 8/02	3	2	„ 5 „	3 m.
„ γ	Oct. 18/02	2	3	„ 6½ „	4½ „
„ γ	Nov. 11/02	2	4	„ 7½ „	5½ „
		15	13		

3. Doe C (bought April 18, 1902, under breeding age).

		♂.	♀.	♀.	♂.
To α	May 17/02	2	2	About 2 m.	At least 4 m.
„ β	July 2/02	3	–	„ 3 „	„ 4 „
		5	2		

4. Doe D (bought April 18, 1902, under breeding age).

		♂.	♀.	♀.	♂.
To α	May 22/02	1	3	About 2 m.	At least 4 m.
„ β	July 1/02	3	2	„ 3 „	„ 4 „
„ γ	Aug. 20/02	4	4	„ 4½ „	2 m.
„ γ	Oct. 10/02	4	4	„ 6 „	3½ „
„ α	Nov. 25/02	7	–	„ 7 „	At least 10 m
		19	13		

5. Doe E (bought April 18, 1902, under breeding age).

		♂.	♀.	♀.	♂.
To α	May 26/02	4	4	About 2 m.	At least 4½ m.
		4	4		

6. Doe F (bought April 18, 1902, under breeding age).

		♂.	♀.	♀.	♂.
To α	June 4/02	0	1	About 2 m.	At least $4\frac{1}{2}$ m.
,, β	July 23/02	4	3	,, $3\frac{1}{2}$,,	,, 4 ,,
,, γ	Sept. 19/02	4	3	,, $5\frac{1}{2}$,,	,, $3\frac{1}{2}$,,
,, α	Oct. 30/02	1	6	,, 7 ,,	,, 9 ,,
		12	13		

7. Doe B[1] (B + α, born May 11, 1902).

		♂.	♀.	♀.	♂.
To α	July 14/02	2	1	2 m.	At least 6 m.
		2	3		

8. Doe B[2] (B + α, born May 11, 1902).

		♂.	♀.	♀.	♂.
To α	July 12/02	2	1	2 m.	At least 6 m.
,, ϵ	Sept. 25/02	4	2	$4\frac{1}{2}$,,	,, 4 ,,
,, δ	Feb. 2/03	2	1	$9\frac{1}{2}$,,	,, 6 ,,
,, η	May 30/03	4	4	12 ,,	,, 4 ,,
		12	8		

9. Doe B[3] (B + α, born May 11, 1902).

		♂.	♀.	♀.	♂.
To α	July 29/02	2	5	2 m.	At least $6\frac{1}{2}$ m.
,, ϵ	Oct. 1/02	4	5	4 ,,	,, 4 ,,
,, θ	Nov. 13/02	2	3	5 ,,	2 m.
		8	13		

10. Doe C[1] (C + α, born May 17/02).

		♂.	♀.	♀.	♂.
To α	July 25/02	3	2	2 m.	At least $6\frac{1}{2}$ m.
,, ϵ	Sept. 27/02	1	6	4 ,,	,, 4 ,,
,, γ	Nov. 25/02	2	7	6 ,,	,, $5\frac{1}{2}$,,
,, δ	Feb. 2/03	3	2	8 ,,	,, 6 ,,
		9	17		

11. Doe C^2 ($C+\alpha$, born May 17, 1902).

		♂.	♀.	♀.	♂.
To α	Aug. 1/02	1	1	2 m.	At least 6½ m.
,, α	Aug. 22/02	5	1	2½ ,,	,, 7 ,,
,, ε	Sept. 22/02	2	4	3½ ,,	,, 4 ,,
,, ι	Dec. 20/02	3	3	6½ m.	3½ m.
,, ι	Feb. 4/03	3	3	8 ,,	5 ,,
,, κ	May 20/03	–	3	12 ,,	2 ,,
		14	15		

12. Doe D^1 ($D+\alpha$, born May 22, 1902).

		♂.	♀.	♀.	♂.
To α	July 31/02	2	5	1½ m.	At least 6½ m.
,, ε	Oct. 5/02	3	4	3½ ,,	,, 4 ,,
,, θ	Nov. 18/02	5	3	5 m.	2½ m.
,, δ	Jan. 13/02	5	2	7 ,,	5½ ,,
,, δ	Feb. 24/03	4	4	8½ ,,	7 ,,
		19	18		

13. Doe D^2 ($D+\alpha$, born May 22, 1902).

		♂.	♀.	♀.	♂.
To α	Aug. 7/02	1	4	2 m.	At least 7 m.
,, ε	Sept. 30/02	4	4	3½ ,,	,, 4 ,,
,, ε	Oct. 23/02	4	3	4½ ,,	,, 5 ,,
,, ι	Dec. 21/02	3	3	6½ ,,	3½ m.
		12	14		

14. Doe D^3 ($B+\alpha$, born May 22, 1902).

		♂.	♀.	♀.	♂.
To α	Aug. 2/02	3	3	2 m.	At least 7 m.
,, ε	Sept. 29/02	1	4	3 ,,	,, 4
,, γ	Dec. 12/02	3	5	5½ ,,	6 m.
		7	12		

15. Doe $B^{2\cdot 1}$ ($B^2+\alpha$, born July 12, 1902).

		♂.	♀.	♀.	♂.
To α	Sept. 11/02	2	3	2 m.	At least 8 m.
,, α	Nov. 17/02	1	2	4 ,,	,, 10 ,,
,, δ	Jan. 15/03	6	3	6 ,,	5½ m.
,, α	May 21/03	3	2	10 ,,	At least 16 m.
,, η	July 8/03	4	2	12 ,,	,, 5 ,,
		16	12		

16. Doe $B^{2\cdot 2}$ ($B^2+\eta$, born May 30, 1902).

		♂.	♀.	♀.	♂.
To η	July 27/02	5	2	5 w.	At least 6 m.
		5	2		

17. Doe $B^{3\cdot 1}$ ($B^3+\alpha$, born July 29, 1902).

		♂.	♀.	♀.	♂.
To α	Oct. 5/02	4	1	2 m.	At least 9 m.
		4	1		

18. Doe $B^{3\cdot 2}$ ($B^3+\alpha$, born July 29, 1902).

		♂.	♀.	♀.	♂.
To ι	Oct. 30/02	6	4	$2\frac{1}{2}$ m.	$1\frac{1}{2}$ m.
		6	4		

19. Doe $C^{1\cdot 2}$ ($C^1+\alpha$, born July 25, 1902).

		♂.	♀.	♀.	♂.
To α	Oct. 2/02	1	5	7 w.	At least 9 m.
,, α	Jan. 10/03	2	6	5 m.	,, 12 ,,
		3	11		

20. Doe $C^{1\cdot 3}$ ($C^1+\epsilon$, born September 27, 1902).

		♂.	♀.	♀.	♂.
To δ	Feb. 6/03	5	3	4 m.	6 m.
,, ζ	May 20/03	6	2	7 ,,	2 ,,
,, η	June 22/03	6	1	8 ,,	At least 5 m.
		17	6		

21. Doe $D^{1\cdot 1}$ ($D^1+\alpha$, born July 31, 1902).

		♂.	♀.	♀.	♂.
To ϵ	Dec. 5/02	2	1	$3\frac{1}{2}$ m.	At least 6 m.
		2	1		

22. Doe $D^{2\cdot 3}$ ($D^2+\alpha$, born August 7, 1902).

		♂.	♀.	♀.	♂.
To α	Oct. 26/02	5	—	2 m.	At least $9\frac{1}{2}$ m.
		5	—		

23. Doe $D^{3\cdot3}$ ($D^3 + \alpha$, born August 2, 1902).

		♂.	♀.	♀.	♂.
To ι	Oct. 28/02	2	2	2 m.	$1\frac{1}{2}$ m.
		2	2		

24. Doe $C^{1\cdot2\cdot1}$ ($C^{1\cdot2} + \alpha$, born October 2, 1902).

		♂.	♀.	♀.	♂.
To α	Dec. 22/02	2	3	2 m.	At least $11\frac{1}{2}$ m.
		2	3		

25. Doe $C^{1\cdot2\cdot2}$ ($C^{1\cdot2} + \alpha$, born October 2, 1902).

		♂.	♀.	♀.	♂.
To α	Dec. 27/02	2	5	2 m.	At least $11\frac{1}{2}$ m.
		2	5		

26. Doe $C^{1\cdot2\cdot2\cdot1}$ ($C^{1\cdot2\cdot2} + \alpha$, born December 27, 1902.)

		♂.	♀.	♀.	♂.
To α	May 13/03	2	6	4 m.	At least 16 m.
,, η	June 24/03	3	4	5 ,,	,, 5 ,,
		5	10		

27. Doe G (age and ancestry lost, but under 3 months).

		♂.	♀.	♀.	♂.
To ι	May 22/03	1	2	About 3 m.	$8\frac{1}{2}$ m.
,, η	June 29/03	5	2	,, 4 ,,	At least 5 m.
		6	4		

28. Doe H (age and ancestry lost, but under 3 months).

		♂.	♀.	♀.	♂.
To η	July 17/03	6	2	About 3 m.	At least 6 m.
		6	2		

B. *Bucks' Record.*

1. α (bought April 18, 1902, at least 4 months old).

		♂.	♀.
By A	May 9/02	4	—
„ B	May 11/02	4	3
„ C	May 17/02	2	2
„ D	May 22/02	1	3
„ D	Nov. 25/02	7	—
„ E	May 26/02	4	4
„ F	June 4/02	3	1
„ F	Oct. 30/02	1	6
„ B^1	July 14/02	2	3
„ B^2	July 12/02	2	1
„ B^3	July 29/02	2	5
„ C^1	July 25/02	3	2
„ C^2	Aug. 1/02	1	1
„ C^2	Aug. 22/02	5	1
„ D^1	July 31/02	2	5
„ D^2	Aug. 7/02	1	4
„ D^3	Aug. 2/02	3	3
„ $B^{2\cdot1}$	Sept. 11/02	2	3
„ $B^{2\cdot1}$	Nov. 17/02	1	2
„ $B^{2\cdot1}$	May 21/03	3	2
„ $B^{3\cdot1}$	Oct. 5/02	4	1
„ $C^{1\cdot2}$	Oct. 2/02	1	5
„ $C^{1\cdot2}$	Jan. 10/03	2	6
„ $D^{2\cdot3}$	Oct. 26/02	5	—
„ $C^{1\cdot2\cdot1}$	Dec. 22/02	2	3
„ $C^{1\cdot2\cdot2}$	Dec. 27/02	2	5
„ $C^{1\cdot2\cdot2\cdot1}$	May 12/03	2	6
		71	77

2. β (bought May 30, 1902, at least 4 months old).

		♂.	♀.
By A	June 22/02	4	3
„ B	July 16/02	4	1
„ C	July 2/02	3	—
„ D	July 1/02	3	2
„ F	July 23/02	4	3
		18	9

3. γ (B + α, born May 11, 1902).

		♂.	♀.
By A	Oct. 2/02	4	—
,, B	Sept. 8/02	3	2
,, B	Oct. 18/02	2	3
,, B	Nov. 11/02	2	4
,, D	Aug. 20/02	4	4
,, D	Oct. 10/02	4	4
,, F	Sept. 19/02	4	3
,, C^1	Nov. 25/02	2	7
,, D^3	Dec. 12/02	3	5
		28	32

4. δ (B + β, born July 16, 1902).

This buck, when 4 weeks old, was placed in a large cage with the following six does, all of which were under breeding age: $B^{1\cdot 1}$, F^1, F^2, $D^{2\cdot 1}$, $D^{2\cdot 2}$, $C^{1\cdot 1}$. The young of course were all mixed, but altogether 27 ♂ and 24 ♀ were born between November 9, 1902, and January 17, 1903. The buck was then put separately to five does with the following result:—

		♂.	♂.
By B^2	Feb. 2/03	2	1
,, C^1	Feb. 2/03	3	2
,, D^1	Jan. 13/03	5	2
,, D^1	Feb. 24/03	4	4
,, $B^{2\cdot 1}$	Jan. 15/03	6	3
,, $C^{1\cdot 3}$	Feb. 6/03	5	3
		21	11
Previous record with young does		27	24
		48	35

5. ϵ (Bought September 6, 1902, at least 4 months old.)

		♀.	♀.
By B^2	Sept. 25/02	4	2
,, B^3	Oct. 1/02	4	5
,, C^1	Sept. 27/02	1	6
,, C^2	Sept. 22/02	2	4
,, D^1	Oct. 5/02	3	4
,, D^2	Sept. 30/02	4	4
,, D^2	Oct. 23/02	4	3
,, D^3	Sept. 29/02	1	4
,, $D^{1\cdot 1}$	Dec. 5/02	2	1
		25	33

6. ζ (ancestry lost, about 2 months old).

		♂.	♀.
By $C^{1 \cdot 3}$	May 20/03	6	2

7. η (bought May 1, 1903, at least 4 months).

		♂.	♀.
By $C^{1 \cdot 3}$	June 22/03	6	1
,, B^2	May 30/03	4	4
,, $C^{1 \cdot 2 \cdot 2 \cdot 1}$	June 24/03	3	4
,, G	June 29/03	5	2
,, $B^{2 \cdot 1}$	July 8/03	4	2
,, H	July 17/03	6	2
,, $B^{2 \cdot 2}$	July 27/03	5	2
		33	17

8. θ ($C^2 + \alpha$, born August 22, 1902).

		♂.	♀.
By B^3...........	Nov. 13/02	2	3
,, D^1	Nov. 18/02	5	3
		7	6

9. ι ($C^2 + \alpha$, born August 22, 1902).

		♂.	♀.
By C^2...........	Dec. 20/02	3	3
,, C^2...........	Feb. 4/03	3	3
,, D^2	Dec. 21/02	3	3
,, $B^{3 \cdot 2}$..........	Oct. 30/02	6	4
,, $D^{3 \cdot 3}$..........	Oct. 28/02	2	2
,, G	May 22/03	1	2
		18	17

10. κ ($C^2 + \iota$, born March 1, 1903).

		♂.	♀.
By C^2...........	May 20/03	0	3